TreeBUGS Practice

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The 2-High-Threshold Source-Monitoring Model (2HTSM)

The following exercises serve as practice tasks for TreeBUGS and are based on the supplementary material of the paper Heck, Arnold, & Arnold (2018) in *Behavior Research Methods*.

Data

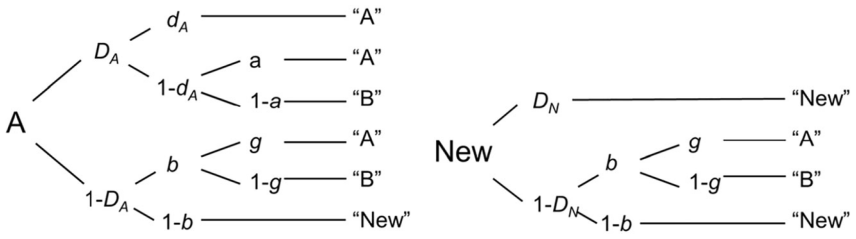
The data are taken from Arnold et al. (2013) from a study on source memory. After learning words from two sources (E = expected and U = unexpected), participants categorized studied and new words in a test list as "old - source E", "old - source U" or "new (N)". This results in 3×3 response categories: (EE,EU,EN), (UE,UU,UN), and (NE,NU,NN). Moreover, participants were assigned to two between-subject groups that differed in the time of schema activation ("retrieval" vs. "encoding").

All data are in the folder `/data`:

- Response frequencies are in `data_both.csv` (and also split by group in `data_retrieval.csv`, `data_encoding.csv`).
- The data files `pc_***.csv` contain the continuous covariate "perceived contingency", a hypothesized predictor for the response bias parameter for source guessing (parameter `b`).
- The data file `group.csv` contains a discrete grouping variable for the data set `data_both.csv`

MPT Model

The MPT model equations for the 2HTSM and the corresponding parameter constraints are in the folder `/model` (files: `2htsm.eqn` and `restrictions.txt`). The model assumes that items are recognized as OLD or NEW with probability $D_1 = D_2 = D_3$ (item memory). Moreover, conditional on recognizing an item as OLD or NEW, a person remembers the source correctly with probability $d_1 = d_2$ (source memory). Finally, the model assumes a source-guessing parameter $a = g$ and one old/new-guessing parameter b.



The first lines of the EQN file for expected items (source E) are:

```
E     EE     D1*d1            # item detection and source detection
E     EE     D1*(1-d1)*a      # item detection and source guessing
E     EU     D1*(1-d1)*(1-a)
E     EE     (1-D1)*b*g       # guessing for both item and source
E     EU     (1-D1)*b*(1-g)
E     EN     (1-D1)*(1-b)
```

Exercises: Basics

1. Plot the individual frequencies in the "retrieval" condition to assess heterogeneity.
2. Fit a latent-trait MPT to the data from the "retrieval" condition.
3. Fit a beta-MPT and compare the estimates on the group level (just look at the summaries).
4. Check convergence and extend sampling if necessary.
5. Test the model fit graphically and with posterior-predictive p-values.
6. Plot the parameter estimates.

Exercises: Advanced

7. *Within-subject test:* Compute and summarize the difference of the parameters D (item memory) and d (source memory).
   - Note: This comparison is not at all substantively meaningful!
8. *Between-subject test:* Fit the latent-trait MPT to the data from both the "retrieval" and the "encoding" condition separately and compute the difference of the parameter D across conditions.
9. *Continuous predictor:* Fit the latent-trait MPT to the "retrieval" condition with "pc" as a continuous predictor for the response-bias parameters b and a
10. *Discrete predictor* (= between-subject tests with identical covariance matrix across groups): Fit the latent-trait MPT to the data from both conditions jointly with the grouping variable "group" (in the data file: `group.csv`) as a discrete, fixed-effects predictor for all 4 parameters.
11. Plot the default prior TreeBUGS uses for the latent-trait MPT.
12. Generate frequencies from the prior predictive distribution for 32 items per MPT tree (i.e., 32 source E, 32 source U, 32 new) and $N = 100$ participants.
    - [Difficult] If you have experience with data manipulation in R: compute the average hit-rate (E or U responses to E or U items) and false-alarm rate (E or U responses to N items) for each replication (in a `for` loop) and plot these rates as points in the ROC space (x = false alarm, y = hit rate).